REMARKS

Claims 1-37 are pending in the present application. Claims 1-24 are rejected. Claims 1 and 14 are herein amended. Claims 25-37 are herein added.

Claim Rejections under 35 U.S.C. §102(b)

Claims 1-2 are rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,886,367 to Udagawa.

Applicants respectfully disagree with the rejection. Applicants note that Udagawa discloses in column 4, lines 14 to 17 that it is desirable for the upper cladding layer to have a thickness of around 0.02 μm to 0.5 μm.

The prior art shown in Fig. 8 in the present application discloses that the Al composition ratio of the p-AlGaN cladding layer 91 is increased (made larger than 0.07, for example) in order to prevent the vertical transverse mode from being the high-order mode (page 4, lines 13 to 24 in the English specification).

Applicants respectfully disagree with the Examiner's characterization of the cited reference, and therefore with the conclusion.

The thickness of the instantly claimed cladding layer is no more than 0.3 μm, thereby making it possible to prevent light from spreading out of the light emitting layer into the cladding layer, and the aluminum composition ratio of the cladding layer is no more than 0.05, thereby making it possible to reduce a strain induced at the time of growing the nitride based semiconductor layer and

to prevent the nitride based semiconductor layer from being cracked (page 22, lines 21 to 23, and page 24, lines 2 to 10 in the English specification).

Applicants note that Udagawa does not disclose that the aluminum composition **of the cladding layer** is preferably no more than 0.05 at column 4, lines 28-29. Rather, Udagawa discloses that the aluminum composition **of the active layer** is preferably no more than 0.05. Furthermore, Udagawa does not appear to disclose aluminum in the cladding layer at all. Because not all of the limitations of the claim are present in the cited reference, Applicants submit that the rejection of claim 1 is improper and should be withdrawn.

Claim Rejections under 35 U.S.C. §103(a)

Claims 3, 5-10, 12-14, 16-20, and 23-24 are rejected under 35 U.S.C. §103(a) as being unpatentable over Udagawa in view of admitted prior art in the disclosure of his invention.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the invention by Udagawa so as to include the further limitation of claim 3.

Applicants respectfully disagree with the above rejection as to amended claim 1 and its dependent claims. Applicants note that the thickness of the instantly claimed cladding layer is no more than 0.3 μm, thereby making it possible to prevent light from spreading out of the light emitting layer into the cladding layer, and the aluminum composition ratio of the cladding layer is no more than 0.05, thereby making it possible to reduce a strain induced at the time of growing the

nitride based semiconductor layer and to prevent the nitride based semiconductor layer from being cracked (page 22, lines 21 to 23, and page 24, lines 2 to 10 in the English specification).

Applicants note that Udagawa does not disclose that the aluminum composition **of the cladding layer** is preferably no more than 0.05 at column 4, lines 28-29. Rather, Udagawa discloses that the aluminum composition **of the active layer** is preferably no more than 0.05. Furthermore, Udagawa does not appear to disclose aluminum in the cladding layer at all. Because not all of the limitations of the claim are taught or suggested in the cited reference, Applicants submit that the rejection of claim 1 is improper and should be withdrawn. And because claims 2-13 are dependent from claim 1 and necessarily include its limitations, Applicants submit that these claims are allowable as well.

In regard to claim 14, the Examiner asserts that the optical guide layer 90 and the contact layer 92 in the admitted prior art are the same p-GaN, and therefore that their implied functional potentials are the same, while it is an obvious advantage to use a contact layer that also performs the role of an additional optical layer. Furthermore, layer 92 is formed on the active layer 89, while by virtue of its constitution it has a larger band gap and lower refractive index than the active layer. Therefore, the Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the invention by Udagawa to include the limitations defined by claim 14.

Applicants respectfully disagree with this rejection. Applicants note that the Examiner appears to consider that the p-GaN contact layer 92 in the prior art shown in Fig. 8 in the present application corresponds to an optical guide layer. The Examiner further appears to consider that the

p-GaN contact layer 92 in Fig. 8 has a larger band gap than the active layer 89 and has a lower refractive index that the active layer 89, similarly to the p-GaN optical guide layer 90 because the p-GaN contact layer 92 is composed of the same material as that of the p-GaN optical guide layer 90.

Applicants note that Claim 14, as herein amended, defines that the ohmic electrode is directly formed on the optical guide layer of a first conduction type without interposing a cladding layer and a contact layer between the electrode and the optical guide layer (corresponding to the embodiment shown in Fig. 5 in the present application).

Applicants herein amend claim 14 to more clearly define the invention, and in order to clearly distinguish the optical guide layer of a first conductivity type from the contact layer.

The optical guide layer of a first conduction type in claim 14 is included in the light emitting layer, and the electrode is brought into ohmic contact with the optical guide layer of a first conduction type in the light emitting layer. Contrary to this, the p-GaN contact layer 92 in the prior art shown in Fig. 8 in the present application is formed on the p-GaN optical guide layer 90 with the p-AlGaN cladding layer 91 interposed between and is not included in the light emitting layer 87.

Furthermore, Applicants submit the following comments on the rejection of claim 14:

Applicants note that the Examiner contends that the present invention is obvious because the material (p-GaN) composing the contact layer and the material (p-GaN) composing the optical guide layer are the same. However, Applicants note that the contact layer and the optical guide layer entirely differ from each other in their functions. That is, the contact layer is a layer provided in

order to reduce the contact resistance with an electrode. When the electrode is directly formed on the cladding layer, the contact resistance is generally increased. Accordingly, the contact layer has its object to prevent the contact resistance. On the other hand, the optical guide layer is a layer provided in a part of the light emitting layer to improve confinement of light.

The contact layer is a layer provided on the cladding layer. Applicants submit that the technical idea that the contact layer is provided on the active layer would not have been obvious to one of ordinary skill in the art.

The present invention uses a structure in which the electrode is directly formed on the optical guide layer, as described on page 26, lines 8 to 16 in the specification, thereby limiting spreading of light in the optical guide layer. As the result of this, a high-order mode in a vertical transverse mode can be cut off (the transverse mode is stabilized), a threshold current is reduced, and focusing characteristics are improved.

It is widely know that a semiconductor laser has a double hetero structure. That is, cladding layers provided above and below the active layer are constituent elements which are indispensable for the semiconductor laser. In the present invention, the cladding layer is not provided on an upper part of the active layer. Applicants submit that such a structure would not have been obvious to one of ordinary skill in the art.

Claims 4, 15, and 21 are rejected under 35 U.S.C. §103(a) as being unpatentable over Udagawa and the admitted prior art as applied to claim 3 above, and further in view of Steigerwald (JOM, volume 49, issue 9, pp. 18-23 (1997)).

The Examiner concludes it would have been obvious to one of ordinary skill in the art to modify the invention as defined by claim 3 so as to include the further limitation as defined by claim 4.

However, as indicated above, Applicants respectfully submit that claim 3 is not obvious in light of the cited reference, because claim 1 is not obvious in light of the cited reference. Applicants note that Udagawa does not disclose that the aluminum composition **of the cladding layer** is preferably no more than 0.05 at column 4, lines 28-29. Rather, Udagawa discloses that the aluminum composition **of the active layer** is preferably no more than 0.05. Furthermore, Udagawa does not appear to disclose aluminum in the cladding layer at all. Because not all of the limitations of the claim are taught or suggested in the cited reference, Applicants submit that the rejection of claim 1 is improper and should be withdrawn. And because claim 4 is dependent from claim 1 and necessarily include its limitations, Applicants submit that these claims are allowable as well.

As to claims 15 and 21, these claims are dependent from claim14 and necessarily include its limitations. And as noted above, Applicants submit that claim 14 is not obvious in light of the cited references. Applicants note that Claim 14, as herein amended, defines that the ohmic electrode is directly formed on the optical guide layer of a first conduction type without interposing a cladding layer and a contact layer between the electrode and the optical guide layer (corresponding to the embodiment shown in Fig. 5 in the present application).

Applicants herein amend claim 14 to more clearly define the invention, and in order to clearly distinguish the optical guide layer of a first conductivity type from the contact layer.

The optical guide layer of a first conduction type in claim 14 is included in the light emitting layer, and the electrode is brought into ohmic contact with the optical guide layer of a first conduction type in the light emitting layer. Contrary to this, the p-GaN contact layer 92 in the prior art shown in Fig. 8 in the present application is formed on the p-GaN optical guide layer 90 with the p-AlGaN cladding layer 91 interposed between and is not included in the light emitting layer 87.

Claim 11 is rejected under 35 U.S.C. §103(a) as being unpatentable over Udagawa in view of U.S. Patent No. 6,069,394 to Hashimoto et al. The Examiner concludes it would have been obvious to one of ordinary skill in the art to modify the invention by Udagawa at the time it was made so as to include the further limitation of claim 11.

As noted above, Applicants respectfully submit that the invention of claim 1, as herein amended, is not obvious in light of the cited reference. And since claim 11 is dependent from claim 1 and necessarily includes its limitations, Applicants submit that it is similarly not obvious.

New claims 25-37 are herein added. Applicants submit that the difference between the added claims and the cited reference is as follows:

In the conventional semiconductor laser shown in Fig. 8, there is a problem that the vertical transverse mode easily becomes a high-order mode. Therefore, it is difficult to reduce a threshold current (described on page 4, lines 7 and 12 in the English specification). Contrary to the problem, the features of the present invention are described in detail on page 19, line 16 to page 24, line 12 in the specification using Fig. 3 and Fig. 4. The features of the present invention are that a threshold current can be reduced and focusing characteristics are improved because the vertical transverse

mode can be a lowest-order fundamental mode (page 20, lines 17 to 20). Further, the present invention produces such effects that it is possible to reduce a voltage, prevent cracking, and improve the yield of the device (page 23, line 18 to page 24, line 22).

On the other hand, Udagawa discloses only a light emitting diode (LED) and does not disclose anything about the stability of a mode which is a problem inherent in semiconductor lasers. That is, Udagawa does not disclose the above-mentioned problem inherent in peculiar to the conventional semiconductor laser. Therefore, it would have been unforeseen to combine the conventional semiconductor laser shown in Fig. 8 with Udagawa in order to solve the above-mentioned problem. Applicants further note that Hashimoto fails to disclose anything about the stability of the mode which is the above-mentioned problem inherent in semiconductor lasers.

In view of the aforementioned amendments and accompanying remarks, Applicants respectfully submit that claims 1-37, as herein amended, are in condition for allowance. Applicants earnestly request such allowance at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for appropriate disposition of this case.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**<u>Version with markings to show changes made</u>**."

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees that may be due with respect to this paper to Deposit Account No. 01-2340.

Respectfully submitted,

ARMSTRONG, WESTERMAN & HATTORI, LLP

Kenneth H. Salen
Attorney for Applicants
Reg. No. 43,077

KHS/meu
Atty. Docket No. **010849**
Suite 1000, 1725 K Street, N.W.
Washington, D.C. 20006
(202) 659-2930

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Enclosures: Version with markings to show changes made

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VERSION WITH MARKINGS TO SHOW CHANGES MADE
Serial No. 09/898,043

IN THE TITLE OF THE INVENTION:

The title of the invention is changed from:

NITRIDE BASED SEMICONDUCTOR LIGHT EMITTING DEVICE"

to:

NITRIDE BASED SEMICONDUCTOR LIGHT EMITTING DEVICE AND NITRIDE BASED SEMICONDUCTOR LASER DEVICE

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) A nitride based semiconductor light emitting device comprising:

a light emitting layer composed of a Group III nitride based semiconductor and including an active layer; and

a cladding layer of a first conduction type composed of a Group III nitride based semiconductor, formed on said light emitting layer, having a larger band gap than said active layer, and having a lower refractive index than the active layer,

the thickness of said cladding layer of a first conduction type being less than 0.3 μm, and said cladding layer of a first conduction type has an aluminum composition ratio of not more than 0.05.

14. (Amended) A nitride based semiconductor light emitting device comprising:

a light emitting layer composed of a Group III nitride based semiconductor ~~and including an active layer and an optical guide layer of a first conduction type formed on said active layer~~ ; and

an electrode which is brought into ~~ohmic~~ contact with said ~~optical guide layer of a first conduction type~~ light emitting layer , wherein

said light emitting layer includes an active layer and an optical guide layer of a first conduction type formed on said active layer,

~~the~~ said optical guide layer of a first conduction type ~~having~~ has a larger band gap than ~~the~~ said active layer and ~~having~~ has a lower refractive index than ~~the~~ said active layer, and

said electrode is brought into ohmic contact with said optical guide layer.

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25. (New) A nitride based semiconductor laser device comprising:

a light emitting layer composed of a Group III nitride based semiconductor and including an active layer; and

a cladding layer of a first conduction type composed of a Group III nitride based semiconductor, formed on said light emitting layer, having a larger band gap than said active layer, and having a lower refractive index than the active layer,

the thickness of said cladding layer of a first conduction type being less than 0.3 μm.

26. (New) The nitride based semiconductor laser device according to claim 25, wherein said cladding layer of a first conduction type has an aluminum composition ratio of not more than 0.05.

27. (New) The nitride based semiconductor laser device according to claim 25, wherein

said light emitting layer further includes an optical guide layer of a first conduction type formed on said active layer,

said optical guide layer of a first conduction type has a smaller band gap and a higher refractive index than said cladding layer of a first conduction type and has a larger band gap and a lower refractive index than said active layer, and

said cladding layer of a first conduction type is formed on said optical guide layer of a first conduction type.

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28. (New) The nitride based semiconductor laser device according to claim 27, wherein

said light emitting layer further includes a carrier leakage preventing layer of a first conduction type formed on said active layer and having a larger band gap than said optical guide layer of a first conduction type, and

said optical guide layer of a first conduction type is formed on said carrier leakage preventing layer of a first conduction type.

29. (New) The nitride based semiconductor laser device according to claim 25, wherein

said cladding layer of a first conduction type has a ridge portion, and

the thickness of said ridged portion is less than 0.3 μm.

30. (New) The nitride based semiconductor laser device according to claim 25, wherein

said Group III nitride based semiconductor contain at least one of boron, gallium, aluminum, indium, and thallium.

31. (New) The nitride based semiconductor laser device according to claim 25, wherein

said cladding layer of a first conduction type contains gallium and aluminum.

32. (New) The nitride based semiconductor laser device according to claim 25, wherein

said active layer contains gallium and indium.

33. (New) The nitride based semiconductor laser device according to claim 25, wherein

said active layer has a multi-quantum well structure alternately including one or more well layers and a plurality of quantum barrier layers, and

the band gap of the active layer is the band gap of said one or more well layers.

34. (New) The nitride based semiconductor laser device according to claim 25, wherein

the electric field distribution of laser light in the active layer is changed in accordance with a sine function or a cosine function, and

the electric field distribution of laser light in the cladding layer of a first conduction type is changed in accordance with an exponential function.

35. (New) The nitride based semiconductor laser device according to claim 25, further comprising a current blocking layer formed on or in said cladding layer of a first conduction type and having a striped opening.

36. (New) The nitride based semiconductor laser device according to claim 25, wherein said first conduction type is a p type.

37. (New) The nitride based semiconductor laser device according to claim 25, further comprising

a cladding layer of a second conduction type composed of a Group III nitride based semiconductor,

said light emitting layer is formed on said cladding layer of a second conduction type.